



FERNALD

Environmental Management Project

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COPPER INGOT DISPOSITION ALTERNATIVES

Overview

The Department of Energy (DOE) completed analyses to select a disposition alternative for 59 metric tons of copper ingots from the Fernald Environmental Management Project (FEMP).

A range of competing disposition methods was analyzed and two leading alternatives identified: 1) recycle at a copper refinery, and 2) the default option of disposal as low level waste. To allow unrestricted release for recycle, authorized limits were developed in accordance with DOE Order 5400.5 *Radiation Protection of the Public and the Environment* and the DOE *Handbook for Controlling Release for Reuse or Recycle of Property Containing Residual Radioactive Material*. To compare the recycle and disposal alternatives, the Draft *Final Decision Methodology for Fernald Material Disposition Alternatives* was utilized as the decision-making framework.

Results

Alternative 1, recycle at a copper refinery, complies with all regulatory requirements, is protective of human health, and is more cost effective than the disposal alternative. The recycle alternative dominated the disposal alternative when analyzed under the *Decision Methodology*, producing performance measures that were as good as, or better than, disposal in every case.

Background

During the mid-seventies 1,090 metric tons of scrap copper motor windings and electrical bus bar from the DOE gaseous diffusion plants were sent to the Fernald site for recycle. About 109 metric tons of this scrap was melt-refined in 1980 to produce "clean" copper ingots for reuse/recycle. Fifty metric tons of the copper were used to manufacture components for use at the DOE Hanford site. The remaining 59 metric tons

remained in storage at Fernald pending development of release limits to address the slight amount of volumetric (mass) contamination.

Authorized Limits

Under DOE Order 5400.5, authorized limits may be developed on a case-by-case basis to provide standards for release of materials with volumetric contamination. In January 1997, DOE initiated an effort to develop release limits for the copper ingots using the most recent DOE guidance and state-of-the-art pathway analysis tools.

Some of the key steps in developing authorized limits and the results from the analysis are described below:

Characterization of the copper ingots.

The scrap copper was shredded, granulated, air separated from plastic and insulation, and finally melt-refined in vacuum induction furnaces in Plant 5. The resulting copper ingots cast from the process have the following physical attributes:

- approximately 270 ingots;
- 7-8" diameter x 30" high cylinders;
- average weight 480 pounds.

The copper ingots are considered high-grade scrap copper and based on minor chemical impurities would require refining prior to use in electrical applications.

The ingots average 4.25 pico-Curies per gram of uranium (1.6 ppm) which is within the range of natural uranium found in Ohio soils. If all of the uranium were removed from within the 59 metric tons of copper, it would amount to 353 grams (about 3/4 of a pound).

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Dose assessment to determine radiation exposures under release scenarios.

The dose assessment was completed using the RESRAD-RECYCLE pathway analysis computer model, which is designed specifically for scrap metal recycle. Exposures to workers and members of the general public were calculated for individual exposures during each step of the copper recycling process including transportation, refining, semi-fabrication, manufacturing, and end-product use.

Dose to the maximally exposed individual (MEI) and cumulative population doses were calculated for the "actual and likely" and "worst plausible" release scenarios. The highest modeled exposures were as follows:

Exposure	Individual Dose (mrem/yr)	Cumulative Dose (person-rem)
Scrap loader	0.0013	0.000002
Slag worker	0.0177	0.000018
Plumbing tube	0.0007	0.031
Frying pan	0.0005	0.011
Copper IUD	0.0001	0.043

The dose to the MEI is well below the 100-mrem annual dose limit specified in DOE Order 5400.5.

Cost analysis to determine the full life cycle cost of implementing a selected alternative.

The sale of 59 metric tons of copper ingots as copper scrap is estimated to generate nearly \$60,000 in revenue for DOE compared with a cost for off-site disposal of about \$40,000. This cost differential provides ample margin in the event some surface decontamination is required prior to release.

ALARA analysis to confirm that the alternative maintains radiation exposures as low as reasonably achievable.

ALARA analysis demonstrated that exposures were as low as reasonably achievable, with doses less than a few mrem per year for the MEI and cumulative population doses well below 10 person-rem.

Additional criteria that may influence selection of a disposition alternative.

Additional factors considered included schedule impacts, local economic impacts, institutional preferences, local social preferences, and environmental impacts. The recycle alternative was as good as, or better than, the disposal alternative for each of these performance measures.

Next Steps

Stakeholder Coordination – DOE will respond to any stakeholder issues or questions raised concerning the project.

Application for Authorized Limits – DOE will coordinate with regulators and obtain formal approval from the Ohio Field Office for implementation.

For More Information...

Call DOE Public Information Officer Gary Stegner at (513) 648-3153, or write to him at the following address:

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